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REVIEW.

AN INTRODUCTION TO ASTRONOMY. By FOREST RAY MOULTON, Ph. D., Assistant Professor of Astronomy in the University of Chicago. Author of "An Introduction to Celestial Mechanics." New York: The Macmillan Company, 1906. xviii + 557 pages.

In this work Professor MOULTON adds a very interesting and valuable contribution to the literature of descriptive astronomy. To quote from the preface, "An attempt has been made in this volume to give an introductory account of the present state of the science of astronomy. The aim has been to present the subject so that it shall be easily comprehended by the student without mathematical or extensive scientific training, and so that he may obtain from it not only some knowledge of scientific achievements, but also something of the spirit which inspires scientific work." In the opinion of the writer, Professor MOULTON has been generally successful in this attempt, but has failed in some few particulars. The subject-matter of the first chapters is simply and elegantly presented, but when he gets to the subjects of perturbations and evolution of the universe, in which the author is perfectly at home, he becomes too technical for the average student and handles such formidable terms as "moment of momentum" as though they were quite commonplace expressions. It takes one well acquainted with these subjects to read those chapters understandingly. But to such a one the subjects are presented in a most enjoyable manner. In view of this, it seems difficult to determine for what class of readers the work is intended.

On the whole, the author has succeeded in giving a very satisfactory "account of the present state of the science of astronomy." The book is thoroughly up to date, and very valuable for reference. A copy should be included in every student's library. It is exceedingly well written and well illustrated, and suggests lists of the best works for reference. Sketches of the historical development of various problems are well placed throughout the book. Interest is added here and there by philosophical and psychological discussions on

subjects such as "Equal intervals of time," "Science," "Induction and deduction," etc.

In presenting various theories the author criticises them most fairly and presents all sides with skill. His explanations of modern developments, such as HALE's recent solar investigations, etc., are very good. In many places he gives very clear expositions of different conditions associated with critical stages of periodic changes in different phenomena,—e. g. seasons, various inclinations of Moon's orbit to the equator, etc. Sets of interesting and valuable questions are interspersed throughout.

In the opinion of the writer, there are a few minor adverse criticisms, which will be noted in passing. The author was not compiling a dictionary, and it should not be necessary in a work of this kind to explain the meaning of words such as "luminiferous," "sidereal," "chromatic," etc. I, for one, object to the author's persistent use of the word "planetoid." Scientific literature is too permeated with the word "asteroid" to make the change just for etymological consistency. The word "mare," for instance, will probably always be used in lunar topography; so why change from "asteroid" to "planetoid"?

In the printing of numerical parts the usual form such as 8".7 seems better than that of 8.7" used in the text.

While I have not verified all of the numerical data given, such as those on page 294, I have looked into the more important of them and find them generally correct. In making detailed criticisms by chapters attention will be called to the errors noted.

Chapter I gives the "Preliminary Outline."

Chapter II—"Reference Points and Lines." In several places in defining reference points and lines the sequence is not good. For instance, the vernal equinox is first mentioned on page 30 and is defined on page 32.

Chapter III—"Constellations." This chapter is most pleasing and useful. The introduction of the star-maps is a good feature, and the description of the constellations is well designed to create an interest in observation.

Errata: Page 51, below *Rigel* read β *Orionis* for α *Orionis*;

below *Betelgeuse* read α *Orionis* for β *Orionis*; line 7 from bottom insert minus sign before the declination.

Chapter IV—"Telescopes." In this chapter the optical features of telescopes are very clearly presented.

In the opinion of the writer the method of finding magnifying power (pp. 85-86) is not described completely; mention should have been made of finding the focus of the image of the objective.

Figure 41 (p. 109) presents a very poor chronographic record. The rate of the chronograph was bad and the signals for transits are much too long.

Erratum: Page 85, section 70.—The first sentence defines the *reciprocal* of magnifying power instead of magnifying power itself, as stated.

Chapter V on "The Earth" is extremely good.

Chapter VI—"The Motions of the Earth." The subject-matter of this chapter is well presented. The writer thinks that in discussing variations of latitude his list of stations should have included those in Siberia, Italy, and Cincinnati.

Chapter VII—"The Law of Gravitation." This chapter is excellent. Mention might well have been made of the so-called Invariable Plane.

Chapter VIII—"Time." In this chapter the all-important idea that time is hour-angle is not brought out.

The "mean sun" is not once mentioned. The author may have had some reason for this which is not apparent to me.

Erratum: Page 241.—The Julian calendar is now (since 1900) thirteen days behind the Gregorian, instead of twelve days, as stated in the text.

Chapter IX—"The Moon."

Chapter X—"Eclipses." This subject is presented with great clearness.

Erratum: Page 278, fig. 109.—The point called B in the text has been omitted from the figure.

Chapter XI—"The Solar System." In the opinion of the writer the various methods of determining solar parallax are not fully enough explained.

Pages 303 et al.—The motion of the seventh satellite of *Jupiter* has been shown to be direct. This fact probably became known to the author too late to make the correction.

Erratum: Page 311, line 10 from bottom—For TIETJEN read BAUSCHINGER.

Chapter XII—"The Planets." This chapter contains the most recent results and is very interesting.

Errata: Page 326—In the time of passage of *Deimos* from meridian to meridian read 13.2 hours for 13 hours 15 minutes.

Page 344—The foot-note should include the satellites of *Uranus* and *Neptune*.

Chapter XIII—"Comets and Meteors." This chapter is excellent.

Objection might be made to the author's statement (p. 356) that planet motions are simple while comet motions are complex.

Chapter XIV—"The Sun." This chapter is very good indeed. The author presents the nature of light very clearly. To read the whole chapter understandingly, however, requires some knowledge of optics, and it is rather doubtful if it could be so read "by the student without mathematical or extensive scientific training."

In the subject of spectrum analysis it is to be regretted that it is not clearly explained how a spectrum can be formed by using a grating.

No mention is made of the ultra-violet part of the spectrum.

Chapter XV—"Evolution of the Solar System." This is a most interesting chapter, in that the author presents not only the old nebular hypothesis but also the "Planetesimal Hypothesis" by CHAMBERLIN and himself. The advantages and disadvantages of the older theory are presented quite impartially. In the writer's opinion some objections could have been offered to the latter theory, but this is not the place to give them.

The whole chapter is very well written, but, I am afraid, is not readily understandable by the non-scientific mind. The author here becomes overzealous and goes into the subject too deeply for "An Introduction to Astronomy."

Chapter XVI—"The Stars and Nebulas." This is again an excellent chapter. The author here uses the term "light-year" without defining it. He further introduces the unit of distance, 200,000 times the distance from the Earth to the Sun, which seems unnecessary since we have the light-year.

Erratum: Page 541, near middle—For 10".0 read 0".1.

Several trivial errors, such as always creep into a first edition, have been noted, but need not be mentioned here. They will undoubtedly be eliminated from future editions, of which the writer ventures to predict that there will be many.

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July 6, 1906.
